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EXAMINER	
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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/588,766
Filing Date: August 08, 2006
Appellant(s): KRAUS ET AL.

Robert A. Madsen
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 1/19/10 appealing from the Office action mailed 8/14/09.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

5,032,217	TANAKA	7-1991
2003/0230549	BUCHANAN ET AL.	12-2003
2003/0235985	CHRISTENSON ET AL.	12-2003

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 3-5, 8, 11-15 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent Application Publication 2003/0235985 to Christenson et al. in view of U.S. Patent 5,032,217 to Tanaka and in further view of U.S. Patent application Publication 2003/0230549 to Buchanan et al.

Regarding Claims 3-5, 8, 14 and 17, Christenson et al. teaches a method of selective etching comprising: providing a first material selected from a group comprising materials with a high dielectric constant (Paragraphs 5, 6, 8, 22, 24, 26) on a substrate and providing a second material (silicon dioxide) on a substrate and selectively etching said first material with a selectivity of at least 2:1 (Paragraph 30) towards said second material by a liquid etchant comprising fluoride ions (Paragraphs 32-35) flowing across the substrate surface at a flow of at least 0.05 L/min (especially at least 0.5L/min)

Regarding Claim 17, Christenson teach a continuous flow as a liquid stream onto the substrate may be provided which spreads over the surface (Paragraph 42) but does not expressly teach a free beam is used. However, Tanaka teaches free beam etchant dispersion is a well known alternative to spray etching. (Figure 1, Col. 1-2 shows spray etching, Figures 2-9 and Col. 3-10 teaches free beam method) It would have been obvious to one of ordinary skill in the art at the time of invention to use a liquid stream or free beam in order to enable optical endpoint detection as recited by Tanaka. Christenson teaches a flow of 0.5 to 2 lpm for single wafer spray processors (Paragraph 43) which is sufficient to generate a mean velocity v parallel to the substrate's surface of minimum 0.1m/s as broadly recited by applicant using a free beam or liquid stream wherein the point of impact is moved across the surface as shown in Tanaka. Thus one of ordinary skill in the art would have provided the claimed velocity as a matter of using the free-beam process of Tanaka including established process variables such as nozzle diameter (d), as shown in Fig. 5, and the experimental section of Tanaka. Note that in the experiment, d=4mm which provides the required velocity 0.1 m/s using the volume flow of 0.1 lpm.

Regarding Claim 17, as applied above, Christenson et al. in view of Tanaka teach the method of the invention substantially as claimed including HfO_2 and ZrO_2 as the first material (Paragraphs 8 and 22), and further teaches the material (HfO_2 and ZrO_2) comprises additional elemental constituents to improve etching (Paragraph 22, 24, 26), but do not expressly teach the first material is subjected a pretreatment in order to damage the material's structure, wherein the pretreatment is an energetic particle bombardment providing additional elements. However, Buchanan et al. teach a pre-treatment consisting of energetic particle bombardment may be used prior to wet etching high-k metal oxide (Paragraph 30 teaches HfO_2 and ZrO_2) using fluoride or HF. (See Paragraphs 18, 26-30, 38) It would have been obvious to one of

ordinary skill in the art at the time of invention to use the conventional pre-treatment step (bombardment) in order to damage the crystal lattice of the metal oxide and increase the etch rate as taught by Buchanan et al. *Note that these teachings are entirely consistent with Christenson who teaches a substituted lattice increases the etch rate of HfO_2 and ZrO_2*

Regarding Claims 3 and 5, Christenson et al. teaches the liquid may be dispensed onto the substrate in a continuous flow as a liquid stream and spread over the substrate's surface (See *"cascading or otherwise flowing"* and *"supplied as a flow"* Paragraphs 42 and 43) in a time sequence and may be rotated while exposed to said liquid etchant. (See *centrifugal spray processor*) Tanaka similarly teaches a rotated substrate for free beam etching processes wherein the point of impact is moved across the surface and the substrate is rotated.

Regarding Claim 11, Christenson et al. teach the liquid etchant is selected from a group comprising a solution comprising fluoride ions and an additive for lowering dielectric constant of said solution, an acidic, aqueous solution comprising fluoride ions, an acidic, aqueous solution comprising fluoride ions and an additive for lowering dielectric number e.g. an alcohol. (Paragraphs 32-38)

Regarding Claim 12, Christenson et al. teach the liquid etchant comprises an analytical concentration of less than 0.01 mol/l of fluoride ions, wherein said analytical concentration is calculated as F^-. (Paragraph 35)

Regarding Claim 13, Christenson et al. teach the liquid etchant comprises fluoride ions and has a pH value of below 3. (Paragraph 37)

Regarding Claim 15, Christenson et al. teach the liquid etchant comprises fluoride ions and an additive for lowering dielectric number such as an alcohol in prior art etching solutions. (Paragraph 8) Such would have been obvious to employ to one of ordinary skill in the art at the time of invention.

(10) Response to Argument

Applicant has initially summarized that "the rejection is based on at least two erroneous interpretations of CHRISTENSON: (1) CHRISTENSON suggests an etchant flow velocity parallel to the substrate surface that could be optimized, and (2) CHRISTENSON teaches using Hf02 and Zr02."

However, the argument is not convincing because the rejection relies on a combination with Tanaka to teach flow velocity. Further the rejection relies on a combination with the teachings of Buchanan to teach bombarded Hf02 and Zr02 as claimed.

1. Applicant has argued that "Christenson does not suggest an etchant flow velocity parallel to the substrate surface that could be optimized."

However, the argument is not persuasive since the rejection does not rely on Christenson to teach flow velocity, but relies on a combination of the teachings of Christenson and Tanaka to teach velocity as claimed. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Applicant has argued that "there would be no reason to provide the continuous flow and flow velocity parallel to the substrate surface based on the teachings of Christenson for two reasons:"

"a. etchant flow is not a result effective variable."

Applicant has argued that in contrast with the present invention, Christenson does not recognize that flow rate or velocity is a result-effective variable. However, the argument is not convincing because Christenson expressly teaches that "the flow rate(s) will tend to be selected based on factors including the type(s) of equipment being used." (Paragraph 43) Only in the case of using a small static volume of etching solution and a centrifugal spray processor *with high cross wafer flow rates* does Christenson teach the relative flow rate is not critical. The citation in context clearly indicates that flow rate is a manipulated variable for equipment being used. Moreover, regarding velocity of the flow, the rejection does not rely on Christenson alone, but on a combination of the teachings of Christenson and Tanaka. Tanaka teaches a high velocity stream or free-beam method to enable optical detection in an etching process. Thus, one of ordinary skill in the art would have provided the claimed velocity as a matter of using the free-beam technique of Tanaka in an optical detection process. See process variables such as diameter (d), as shown in Fig. 5, and the experimental section of Tanaka. Note that in the experiment,

d=4mm which provides the required velocity 0.1 m/s using the volume flow of 0.1 lpm as recited in Christenson.

"b. etchant flow is not continuous and parallel to the surface".

Applicant argues that since Christenson uses an immersion or spray technique there is no etchant flow having a mean velocity parallel to the surface. In this case, the rejection does not rely on Christenson alone, but combination with Tanaka (Figures 2, 4 and 6 illustrate flow having mean velocity parallel to the surface) Tanaka teaches free beam etchant dispersion is a well known alternative to spray etching. (Figure 1, Col. 1-2 shows spray etching, Figures 2-9 and Col. 3-10 teaches free beam method) It would have been obvious to one of ordinary skill in the art at the time of invention to use a liquid stream or free beam in order to enable optical endpoint detection as recited by Tanaka. Christenson teaches a flow of 0.5 to 2 lpm for single wafer spray processors (Paragraph 43) which is sufficient to generate a mean velocity v parallel to the substrate's surface of minimum 0.1m/s using a free beam or liquid stream wherein the point of impact is moved across the surface as shown in Tanaka. Thus one of ordinary skill in the art would have provided the claimed velocity as a matter of using the free-beam process of Tanaka including established process variables such as nozzle diameter (d), as shown in Fig. 5, and the experimental section of Tanaka. Note that in the experiment, d=4mm which provides the required velocity 0.1 m/s using the volume flow of 0.1 lpm.

2. Applicant has argued that "Christenson teaches away from etching using HfO2 and ZrO2."

In support, applicant points to portions of Christenson teaching that it is difficult to etch HfO2 and ZrO2. (Paragraph 22) However, the argument is not persuasive because Christenson teaches difficulty only for etching pure material, but teaches success etching with substituted HfO2 and ZrO2 (such as HfSiO2) having additional elements in the lattice. (Paragraphs 22, 24, 26 in context) Moreover, Christenson is not relied upon alone to teach the bombarded material as claimed. Buchanan further teaches HfO2 and ZrO2 may be successfully etched by bombardment substitution. (Paragraphs 18, 26, 30) Thus, in view of the combined teachings of Buchanan and Christenson, one of ordinary skill in the art

would have reasonably expected success etching lattice substituted HfO2 and ZrO2, as shown in Christenson and lattice substituted HfO2 and ZrO2 as shown in Buchanan by ion bombardment.

3. Conclusion

In conclusion, applicant argues that Buchanan fails to disclose or teach the functional effect of velocity on etch selectivity. However, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Roberts Culbert/

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